Attorney Docket No. **09792909-6438** PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:	)	Group Art Unit: **2813**
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Application No. **09/980,024**	)	
	)	
Filed: **May 28, 2002**	)	
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For: **ELECTRICAL CONNECTION MATERIALS AND ELECTRICAL CONNECTION METHOD**	)	
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SUBSTITUTE SPECIFICATION

protrusion electrode 202 and the wiring patterns 303, and electrical connection cannot be obtained.

Accordingly, for example, if an electrical connection via conductive particles is obtained reliably regardless of a little unevenness on printed wiring boards to be an object or regardless of a little unevenness of protrusion electrodes of an IC, it is deemed that sufficient reliability is obtained in practical use even on a printed wiring board whose cost is restrained.

DISCLOSURE OF THE INVENTION

The present invention was developed considering the above points, and an object of the present invention is to provide electrical connection materials and electrical connection methods by which an electrical connection via conductive particles can be reliably performed regardless of a little unevenness in objects.

One aspect of the disclosed invention(s)is an electrical connection material for electrically connecting an electrical connection portion of a first object and an electrical connection portion of a second object and is an electrical connection material characterized by being comprised of a first film-like adhesive layer which is a film-like adhesive layer arranged on the fist object and is composed of a plurality of conductive particles, a first binder containing the conductive particles, and a first filler and a second film-like adhesive layer which is arranged on the first film-like adhesive layer and is composed of a second binder whose viscosity is lower than that of the first binder and a second filler.

In one aspect of the disclosed invention(s), the first film-like adhesive layer is a film-like adhesive layer arranged on the first object and is composed of a plurality of conductive particles, the first binder containing the conductive particles, and the first filler.

The second film-like adhesive layer is arranged on the first film-like adhesive layer and is composed of the second binder and the second filler.

The viscosity of the second binder of the second film-like adhesive layer is set to a value lower than that of the first binder.

By arranging the first film-like adhesive layer for the first object and by pressurizing and heating the second film-like adhesive layer through the second object, only the second film-like adhesive layer flows. Thus, even when there is a little unevenness on the first object, the first object and the second object can be stuck. Therefore, the electrical connection portion of the first object can be electrically connected reliably to the electrical connection portion of the second object, employing the conductive particles of the first film-like adhesive layer.

In another aspect, the conductive particles have an approximately uniform particle diameter. Since the conductive particles have an approximately uniform particle diameter, the

electrical connection portion of the first object and the electrical connection portion of the second object can be electrically connected without rising while having a shape sandwiching the conductive particles reliably.

In another aspect, the material of the second film-like adhesive layer composed of the second binder and the second filler is a binder made of the same material as that of or a material similar to the first binder of the first film-like adhesive layer containing the conductive particles.

Since the second film-like adhesive layer is a binder made of the same material as that of or a material similar to the binder of the first film-like adhesive layer, the binders of the first and second film-like adhesive layers react through pressurization and heating so as to glue the first object and the second object.

Suppose the material of the second binder of the second film-like adhesive layer is different from the material of the first binder of the first film-like adhesive layer, after both the binders are hardened while being mixed, inferred is a possibility that a problem of connection reliability occurs.

In another aspect, the viscosity of the second film-like adhesive layer becomes extremely lower than the viscosity of the first film-like adhesive layer in a heating process. The viscosity of the second film-like adhesive layer is not

necessarily required to be low at room temperature but is required to be extremely lower than that of the first film-like adhesive layer in the process of a thermocompression bonding. On the other hand, when the viscosity of the second film-like adhesive layer is too low at room temperature, a sticking work becomes hard to do.

In another aspect, the thickness of the first film-like adhesive layer containing the conductive particles is set to from approximately the same thickness as the diameter of the conductive particles up to about 4 times the diameter. The conductive particles do not protrude from the first film-like adhesive layer containing the conductive particles. That is, the thickness of the first film-like adhesive layer may be a thickness which can be ensured by the conductive particles, and the thickness of the second film-like adhesive layer has to have a thickness by which the second film-like adhesive layer is reliably filled so that voids do not exist between the first object and the second object.

In another aspect, in order that the viscosity of the second film-like adhesive layer composed of the second binder and the second filler is set to a value lower than the viscosity of the first film-like adhesive layer containing the conductive particles, the diameter of the second filler is set to a value larger than the diameter of the first filler.

Since the viscosity of the second binder is set to a value lower than the viscosity of the first binder, the second film-like adhesive layer between the first object and the second object flows preferentially by heating and pressurization, and thus the first film-like adhesive layer containing the conductive particles does not move, whereby the position of the conductive particles can be maintained surely.

The diameter of the second filler particles contained in the second film-like adhesive layer is set to a value larger than the diameter of the first filler particles contained in the first film-like adhesive layer. Since the diameter of the second filler particles is set to a value larger than the diameter of the first filler particles, it is possible that the viscosity of the second film-like adhesive layer containing the second filler particles with a larger diameter is lower and the viscosity of the first film-like adhesive layer containing the first filler particles is higher.

In another aspect, in order that the viscosity of the second film-like adhesive layer composed of the second binder and the second filler is set to a value lower than the viscosity of the first film-like adhesive layer containing the conductive particles, the content by amount of the second filler is set to a value smaller than the content of the first filler.

Since the viscosity of the second binder is set to a value lower than the viscosity of the first binder, the second film-like adhesive layer between the first object and the second object flows preferentially by heating and pressurization, and thus the first film-like adhesive layer containing the conductive particles does not move, whereby the position of the conductive particles can be maintained surely.

The content of the second filler contained in the second film-like adhesive layer is set to a value smaller than the content of the first filler contained in the first film-like adhesive layer. Since the content of the second filler is set to a value smaller than the content of the first filler, it is possible that the viscosity of the second film-like adhesive layer containing the second filler with a small content is lower and the viscosity of the first film-like adhesive layer containing the first filler is higher.

In another aspect, the first filler and the second filler are materials reducing the coefficient of water absorption and the coefficient of linear expansion of a binder.

By selecting a material for the first filler and the second filler, which can reduce the coefficient of water absorption and the coefficient of linear expansion of an adhesive layer, for example, the reliability of the electrical connection between a

wiring pattern on a circuit substrate and a protrusion electrode of an electrical component can be improved.

By reducing the water absorption coefficient of an adhesive layer, occurrence of package crack due to moisture absorption of the adhesive layer can be restrained in a production process accompanied by a reflow furnace.

By reducing the linear expansion coefficient, stress developed from the difference of the linear expansion coefficients of the first object and the second object due to thermal stress can be mitigated in the adhesive layer, and the connection reliability for thermal stress can be improved.

In another aspect, the electrical connection portion of the first object is a wiring pattern on a circuit substrate, the electrical connection portion of the second object is a protrusion electrode of an electrical component, and the conductive particles in the first film-like adhesive layer containing the conductive particles electrically connect the wiring pattern on the circuit substrate and the protrusion electrode of the electrical component.

In another aspect, the elements of the first binder containing the conductive particles and the second binder of the second film-like adhesive layer are the same or approximately similar.

In another aspect there is an electrical connection material comprising a first film-like adhesive layer composed of a first binder and a first filler and a second film-like adhesive layer which is composed of a second binder and a second filler and is arranged on the first film-like adhesive layer, characterized in that said first binder is made of a first high molecular resin material and said second binder is made of a second high molecular resin material whose molecular weight is smaller than that of said first high molecular resin material.

In another aspect, in order to make the viscosity of the second film-like adhesive layer lower than that of the first film-like adhesive layer, a high molecular resin material whose molecular weight is smaller than that of the first binder constituting the first film-like adhesive layer is employed as the second binder constituting the second film-like adhesive layer to realize a low viscosity.

In another aspect there is an electrical connection method for electrically connecting an electrical connection portion of the first object and an electrical connection portion of the second object and is an electrical connection method characterized by comprising an adhesive layer arrangement step for arranging a first film-like adhesive layer which is composed of a plurality of conductive particles, a first binder containing the conductive particles, and a first filler on the

electrical connection portion of the first object and a second film-like adhesive layer which is composed of a second binder and a second filler on the first film-like adhesive layer, and a connection step for performing heating and pressurization for electrically connecting the electrical connection portion of the first object and the electrical connection portion of the second object by means of the conductive particles of the first film-like adhesive layer.

In this aspect, at the adhesive layer arrangement step, the first film-like adhesive layer is arranged on the electrical connection portion side of the first object, and the second film-like adhesive layer is arranged on the electrical connection portion side of the second object.

At the connection step, in order to electrically connect the electrical connection portion of the first object and the electrical connection portion of the second object by the conductive particles in the first film-like adhesive layer, heating and pressurization are performed.

Thus, only by arranging the first film-like adhesive layer and the second film-like adhesive layer, the conductive particles of the first film-like adhesive layer do not move, and only the second film-like adhesive layer flows. Therefore, even when there is a little unevenness of the first object, the first object and the second object can be stuck, and the electrical

connection portion of the first object can be electrically connected reliably to the electrical connection portion of the second object, employing the conductive particles of the first film-like adhesive layer.

In another aspect, the connection step comprises a first pressurization heating step for heating and pressurizing the first film-like adhesive layer and the second film-like adhesive layer in a temperature range of ±20°C centering a temperature at which the viscosity of the second film-like adhesive layer becomes the lowest and a second pressurization heating step for thereafter heating and pressurizing the first film-like adhesive layer and the second film-like adhesive layer at a temperature higher than reaction start temperature of the first film-like adhesive layer and the second film-like adhesive layer.

In this aspect, the first pressurization heating step is performed where the second film-like adhesive layer is heated and pressurized in a range of ±20°C centering a temperature at which the viscosity of the second film-like adhesive layer becomes the lowest. Then, at the second pressurization heating step, the first film-like adhesive layer and the second film-like adhesive layer are heated and pressurized at a temperature higher than reaction start temperature of the first film-like adhesive layer and the second film-like adhesive layer.

At the first pressurization heating step, since the viscosity of the first film-like adhesive layer is higher than the viscosity of the second film-like adhesive layer, the second film-like adhesive layer is fluidized. Thus, the conductive particles are not fluidized in the first film-like adhesive layer containing the conductive particles, and the conductive particles can be made to exist, for example, between the wiring pattern on the circuit substrate and the protrusion electrode of the electrical component reliably.

At the second pressurization heating step, by heating and pressurizing at a temperature higher than the reaction start temperature, the first film-like adhesive layer and the second film-like adhesive layer are completely hardened.

In another aspect, even in a temperature range of ±20°C centering a temperature at which the viscosity of the first film-like adhesive layer containing the conductive particles and the viscosity of the second film-like adhesive layer become the lowest, the viscosity of the first film-like adhesive layer containing the conductive particles is higher than the viscosity of the second film-like adhesive layer, therefore the second film-like adhesive layer is fluidized. The conductive particles of the first film-like adhesive layer containing the conductive particles is not fluidized, and the conductive particles in the first film-like adhesive layer containing the conductive

particles are made to exist between the wiring pattern on the circuit substrate and the protrusion electrode of the electrical component to electrically connect the wiring pattern and the protrusion electrode.

In another aspect, the becoming-lowest-temperature is 80°C.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a diagram illustrating one example of an electrical device having an electrical connection material of the present invention.

FIG. 2 is a diagram illustrating a state before an IC is connected with a printed wiring board, employing the electrical connection material in FIG. 1.

FIG. 3 is a diagram illustrating a state where the IC is pressed against the printed wiring board via the electrical connection material.

FIG. 4 is a diagram illustrating a state after the IC is attached to the printed wiring board by pressure via the electrical connection material.

FIG. 5 is a diagram illustrating a state where the IC is completely electrically connected to the printed wiring board.

FIG. 6 is a flow chart showing an example of an electrical connection method of the present invention.

FIG. 7 is a graph showing a measurement example of